Factual Report

Fire Aboard Construction Barge *Athena 106*
West Cote Blanche Bay, Louisiana
October 12, 2006

Synopsis

On Thursday, October 12, 2006, about 1155 central daylight time,[1] the uninspected towing vessel *Miss Megan*, owned and operated by Central Boat Rentals, Inc., of Morgan City, Louisiana, was pushing two uninspected deck barges through the West Cote Blanche Bay oil field in St. Mary Parish, Louisiana (**figure 1**).[2] The tow was en route to a pile-driving site in the northwest area of the oil field. Construction barge *Athena 106* (also known as a spud barge), owned and operated by Athena Construction of Morgan City, Louisiana, was tied along the port side of an unmanned deck barge, the *IBR 234*, owned by Inland Barge Rentals of Berwick, Louisiana. The *Miss Megan* was secured astern of the *IBR 234*, pushing both barges. The oil field was operated by Gulfport Energy Corporation. A natural gas pipeline that was involved in the accident was operated by Chevron U.S.A., Inc.

[1] Times in this report are given in central daylight time according to the 24-hour clock.

[2] A deck barge is a manned or unmanned barge that has a continuous, flat main deck. Deck barges are employed to carry deck cargo and are also used in the marine construction industry for such work as pier or bulkhead construction, dredging, and marine oil service. Deck barges that operate on inland waters are uninspected by the U.S. Coast Guard.

Coast Guard regulations contain a category called "uninspected vessels," which includes towing vessels like the *Miss Megan* that are subject to certain regulations, such as those concerning lifesaving apparatus, but that are not subject to Coast Guard inspection. This report uses "uninspected" to refer both to vessels that are regulated but not inspected (the *Miss Megan*) and those that do not fall under the regulations for uninspected vessels (the deck barges).

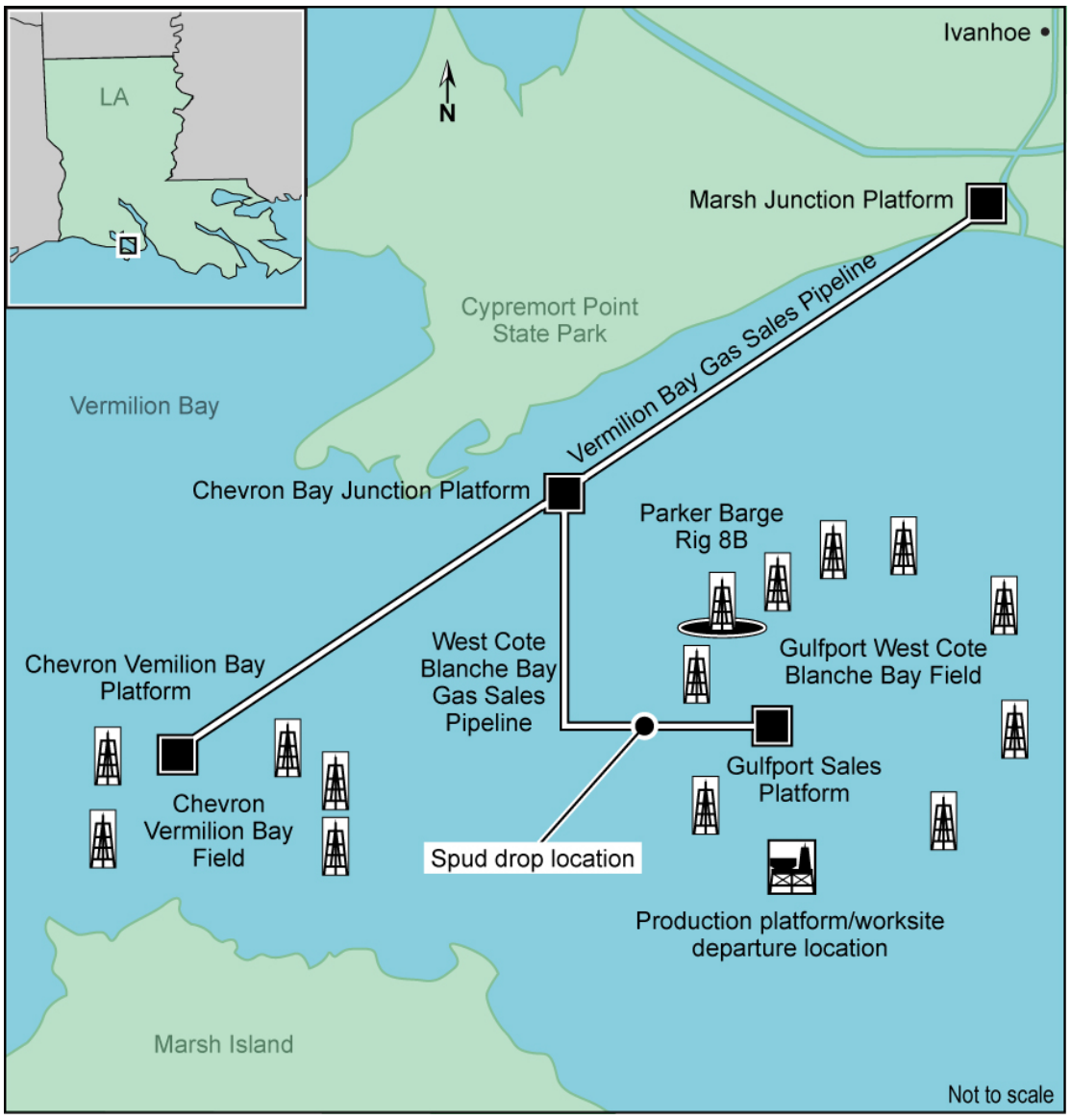

Figure 1. Site where construction barge *Athena 106* dropped a 5-ton mooring spud on the West Cote Blanche Bay natural gas sales pipeline. The pipeline carried excess natural gas from the Gulfport sales platform (where extracted natural gas was processed and injected back into oil-producing wells to aid in oil production) to a junction with Chevron's Vermilion Bay gas sales pipeline. The pipeline between the Gulfport sales platform and the Chevron bay junction platform was about 19,650 feet long. The pipeline between the Vermilion Bay platform and the bay junction platform was about 32,300 feet long.

The *Miss Megan* was crewed by one licensed master and one deckhand. The *Athena 106* had six workers on board—a foreman, a crane operator, and four barge hands. While the construction barge was under way, the aft spud (a vertical steel shaft

extending through a well in the bottom of the boat and used for mooring) dropped from its fully raised position. The steel spud was 20 inches square, had an overall length of 40 feet, and weighed 10,900 pounds.[3] Spuds, rather than anchors, are used to hold deck barges in place during marine construction work (anchor chains would allow the barges to swing). Two spuds are required to keep a barge stationary.

The spud dropped into the water and struck a submerged, buried high-pressure natural gas pipeline. An unknown source ignited the resulting gas release, creating a fireball that engulfed the towing vessel and both barges. The *Miss Megan* master was killed, as were four barge workers. One barge worker and the *Miss Megan* deckhand survived. One barge worker was officially listed as missing at the time of this report.

Accident Narrative

The day of the accident began uneventfully, according to the operator of the winch that controlled the two spuds on the *Athena 106* (**figure 2**). The spud winch operator stated that between 0800 and 0830 that morning, he and the other crewmembers (a foreman, a crane operator, and three other barge hands) boarded a crew transport boat docked at Ivanhoe, Louisiana, for the 30-minute trip to the *Athena 106* barge. When they arrived at the *Athena 106*, the crewmembers set about their daily routine. They were scheduled to extract (pull) pilings that morning until a towboat arrived to push them to their next work location in the same oil field, where they were scheduled to drive (install) pilings around an oil field rig (Parker barge rig 8B).

[3] The aft spud was weighed on a calibrated crane scale at the Athena Construction facility after the accident.

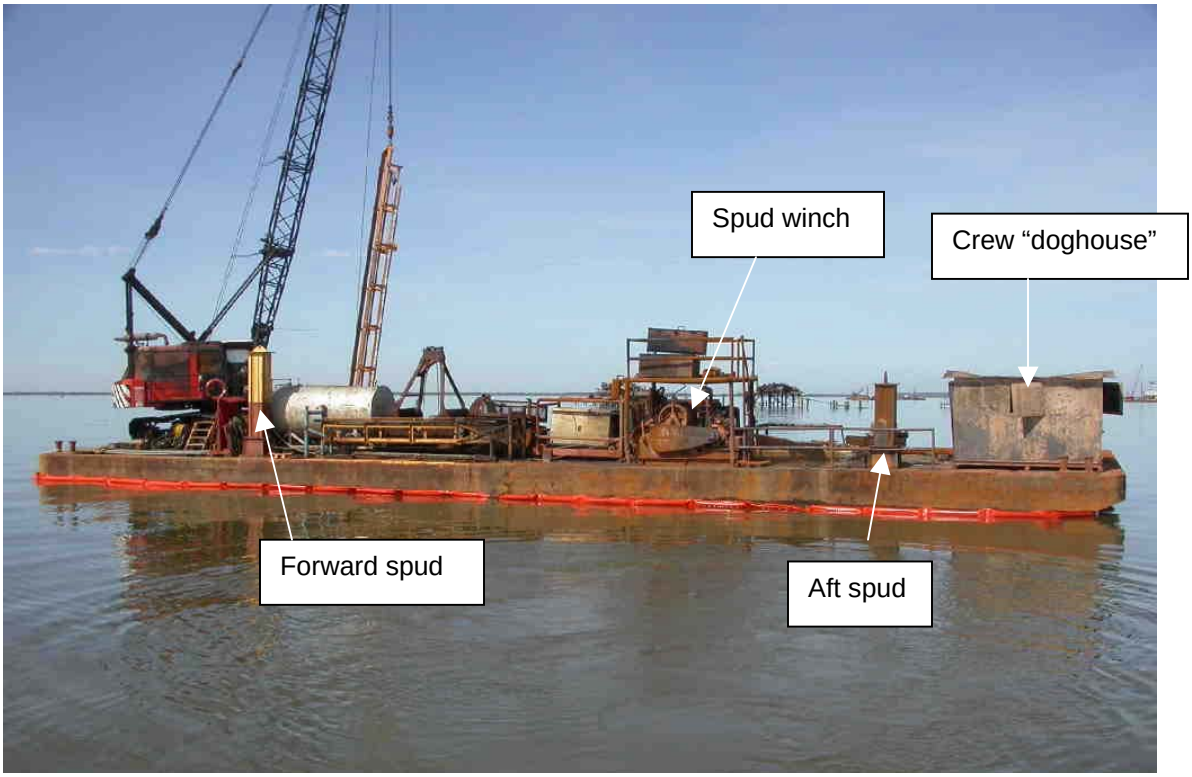

Figure 2. *Athena 106* after the fire. The construction barge was equipped with two mooring spuds (shown in the lowered position), both on the port side, one forward and one aft, controlled by a single winch. At the front of the barge was the crane used to hoist and position pilings for driving or to maneuver them to a barge alongside for storage.

The spud winch operator’s first duties of the day included checking the diesel and oil levels on the barge crane, checking the barge’s air compressor, and checking the oil level in the spud winch gearcase as well as the general condition of the winch. Both spuds were raised and lowered by a single winch equipped with two steel cables, each wound around a drum and attached to one of the spuds (**figure 3**).[4] The spud winch operator said that he would periodically adjust the winch’s foot brakes, which were used to control the speed of the winch drums as they raised or lowered the spuds. He said that on the day of the accident, the foot brakes “felt fine” and did not need adjusting. He

[4] See “Spud Winch Information” section for detailed explanations and illustrations of the spud winch apparatus.

stated that he also checked the condition of the spud-lifting cables daily. Both spud winch cables had been replaced 2 months before the accident, according to documentation provided by the Athena Construction maintenance supervisor.

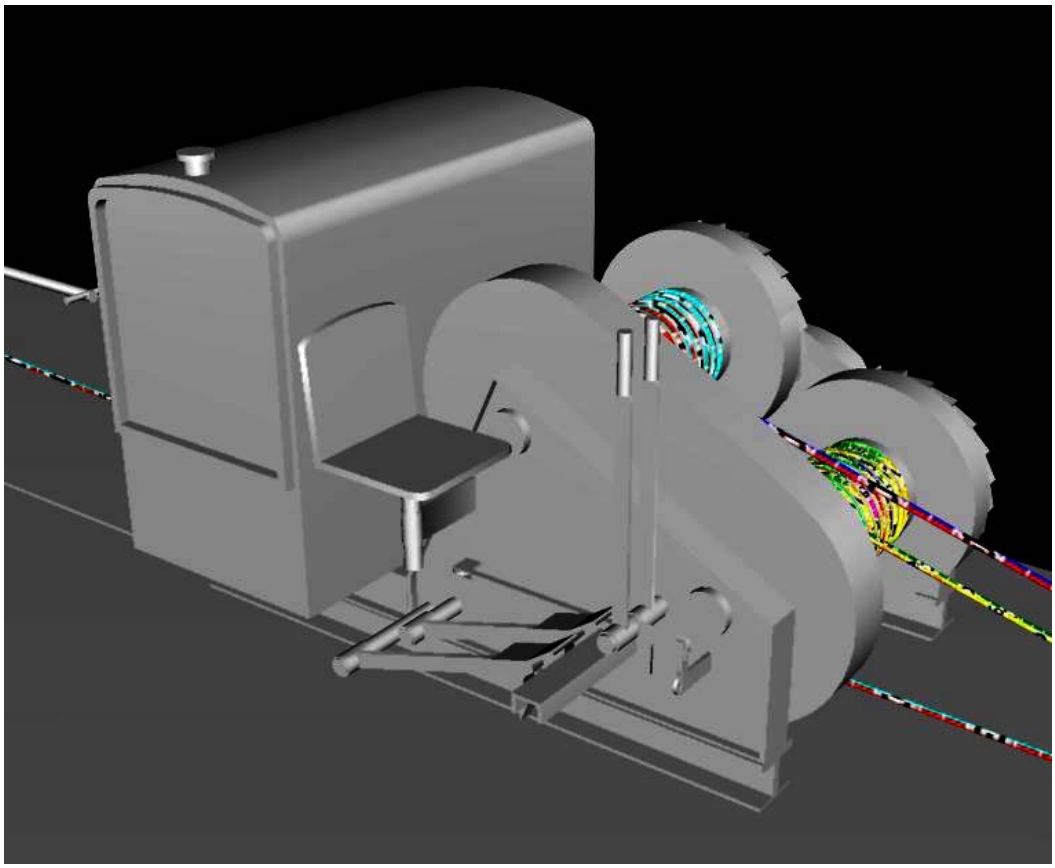

Figure 3. Computer-generated image of a spud winch unit. The spud-lifting cables are wound on the drums to the left of the operator's seat. The winch's foot brakes are below and forward of the seat.

After completing the morning checks, the *Athena 106* crew began extracting pilings. The *IBR 234* was secured alongside the *Athena 106* to store the extracted pilings (**figure 4**). The barge also housed new pilings that would be driven later.

The extraction work continued until about 1130, when the towboat *Miss Megan* arrived and was secured to the aft end of the *IBR 234* in preparation for propelling the

two barges to their next work location (**figure 5**). While the towboat master and deckhand made fast to the barges, the barge crew stopped its work of extracting pilings.

Figure 4. Barge *IBR 234* loaded with pilings (being pushed by the *Miss Megan*).

The *Athena 106* spud winch operator, at the barge foreman's direction, then retracted both spuds to release the barges from their anchorage. The operator said that he encountered no problems with the winch in lifting the spuds. He set the foot brake for each spud drum on the winch to lock the spuds in their fully retracted (lifted) position for the transit to the next work location. The operator said that although the winch was equipped with other safeguards to prevent the unintentional release of a spud, the foot brakes were the only holding or braking mechanism engaged for the transit. (The

operation of the spud winch is discussed in more detail in the "Spud Winch Information" section.)

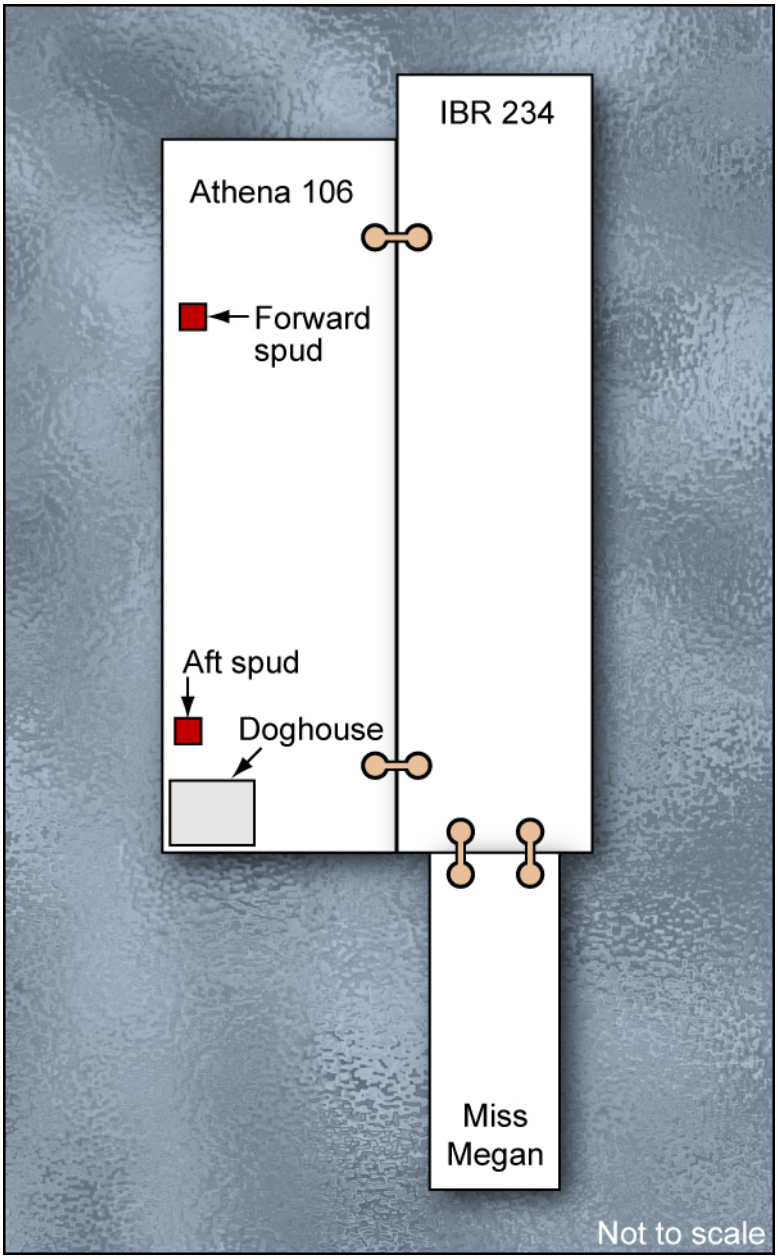

Figure 5. Towing arrangement of the *Miss Megan* and the two barges. The barges were tied together, with the *Miss Megan* secured to the aft end of the *IBR 234* and pushing both barges.

After the towboat was in position for the transit and the *Athena 106*'s spuds were retracted, the barge crew began assembling for lunch in the crew shelter, which they

called the "doghouse." The crewmembers heated their lunch in a microwave oven connected by an extension cord to a small portable generator on the deck. The generator also powered a cooling fan in the doghouse.

The *Miss Megan* master got the towboat under way about 1145. The deckhand then joined the barge crew in the doghouse for lunch. The *Athena 106* spud winch operator said that he and the other three barge hands removed their work vest flotation devices while they ate lunch in the doghouse, as was customary. The towboat deckhand, still wearing his work vest, stood outside the doghouse door to chat while the barge hands ate lunch inside. The deckhand said that neither the barge crane operator nor the foreman was in the doghouse during that time. At some point while the spud winch operator and the other barge hands were eating, one barge hand left the doghouse, leaving the spud winch operator and two barge hands inside and the towboat deckhand standing outside the door.

After finishing his meal, the *Athena 106* spud winch operator called his mother on his cell phone from the doghouse. He said that during the conversation, he heard a large "bam" outside. He estimated that the *Athena 106* had been under way, pushed by the *Miss Megan*, for 8 to 10 minutes. When he heard the noise, he looked out the doghouse door and saw that the aft spud had released and dropped to its fully deployed (down) position. The spud winch operator told investigators that he had felt the barge stop, "like the towboat stopped," before the spud dropped but that he had paid "no attention" because "that's been known to happen out there . . . the water's shallow."[5] Unbeknownst

[5] The *Miss Megan* deckhand, the other survivor, remembered that the barge was "moving slow" before the accident.

to the crewmembers, the spud had struck a high-pressure natural gas pipeline buried in the bay immediately below them.

The spud winch operator said that he wondered what had caused the spud to drop, looked at the winch, and saw no one near it who might have accidentally released the brake. He noticed that the cable on the upper drum connecting the aft spud to the winch was fouled ("birdnested like [the reel on] a fishing pole") on the drum (**figure 6**). The spud winch operator said that he then saw a large "burst" in the water alongside the barge "right where the [aft] spud was." He was looking toward the towboat behind the barge when a large fireball erupted between the aft end of the *Athena 106* and the towboat, with "flames and water . . . going everywhere." The fire engulfed the *Miss Megan.* By that time, the barge's crane operator was beside the spud winch operator and told him to run to the front of the barge, where the crane was stationed. The spud winch operator did not have time to don his flotation work vest after the fireball erupted.

At the forward end of the *Athena 106*, the barge hand who had left the doghouse earlier met the crane and spud winch operators. The spud winch operator and the barge hand jumped from the *Athena 106*'s forward end into the water and swam away from the barge to escape the flames. The spud winch operator recalled looking back at the barge and seeing the crane operator attempting to untie the barges. The spud winch operator also saw the *Miss Megan*'s deckhand, the only other survivor of the accident, in the water at the forward end of the *Athena 106*. He told investigators that he noticed that the deckhand wore his flotation work vest.

Figure 6. Photo showing cable "birdnested" on the winch drum (upper rear) that led to the *Athena 106*'s aft spud. The cable on the lower winch, which led to the forward spud, is properly wound.

The *Athena 106* spud winch operator swam away from the flames and the barge, eventually finding a short piece of lumber to hold onto. He estimated that he had swum 40 yards from the barge when another crew transport boat in the area, the *Captain Mitch*, arrived about 5 minutes after the accident and picked him up while it searched for survivors. The *Miss Megan* deckhand swam away from the burning *Athena 106* and was rescued by four Athena Construction workers in a small boat carried on their nearby barge. Workers on both the *Captain Mitch* and the small boat reported seeing other *Athena 106* crew on or around the burning barge but could not move close enough to help because of the fire's heat.

Pressure readings from Chevron's SCADA system[6] indicated that the natural gas pipeline ruptured about 1155. The SCADA system enabled a rapid shutdown (by about 1210) of the Vermilion Bay gas sales pipeline downstream of the rupture. Pressure gauges sensed a pressure decline in the Vermilion Bay gas sales pipeline, from 700 pounds per square inch, gauge (psig), to 400 psig, and the SCADA system automatically shut it down. As part of the automatic shutdown, a check valve on Chevron's bay junction platform closed and prevented natural gas from backflowing into the ruptured pipeline from the downstream pipeline system. The shutdown of the failed pipeline upstream of the failure was expedited because a workman on the Gulfport sales platform recognized the emergency and, just after 1206, manually shut an upstream valve feeding gas into the failed pipeline.

Injuries

Table 1. Injuries sustained in the *Athena 106* accident.

Type of Injury	*Athena 106*	*Miss Megan*	Total
Fatal	4	1	5
Serious	0	1	1
Minor	1	0	1
Missing[1]	1	0	1
Total	6	2	8

NOTE: Title 49 *Code of Federal Regulations* (CFR) 830.2 defines a fatal injury as any injury that results in death within 30 days of an accident. Serious injury means any injury that (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface.

[1] At the time of the report, one barge worker was officially listed as missing. After the accident, two barge workers were missing. One was declared dead and is included in the fatalities.

[6] SCADA, an acronym for Supervisory Control and Data Acquisition, is a system that monitors or controls water and power supply systems, gas and oil pipelines, and other distribution systems.

Damages

Damages to the *Athena 106* and its equipment were estimated at $150,000. The replacement value of the *Miss Megan* towboat was estimated at $650,000 in an August 2005 vessel survey. The *Miss Megan* was a total constructive loss.

Chevron estimated that about 973,000 standard cubic feet of natural gas escaped from the pipeline in the 15 minutes before it was shut down after the rupture.[7] Chevron estimated the value of the released gas at $6,800 and the cost of removing and replacing the ruptured pipeline at $800,000.

Personnel Information

Miss Megan

Master. Central Boat Rentals hired the 48-year-old master of the *Miss Megan* in June 2001. Because the *Miss Megan* was over 26 feet long, it was required by Federal regulations to be operated by a licensed master.[8] The master of the *Miss Megan* held the required U.S. Coast Guard license, issued in April 2003, as "master of towing vessels upon Great Lakes, inland waters, and western rivers; excepting waters subject to the International Regulations for Preventing Collisions at Sea, 1972; also, radar observer–inland." The license was due to expire in April 2008. The Coast Guard in Morgan City

[7] Standard cubic feet of gas is the volume of gas at standard temperature (60° F) and atmospheric pressure (14.7 pounds per square inch).

[8] Title 46 CFR 15.610 states: "Every towing vessel at least 8 meters (26 feet) in length, measured from end to end over the deck (excluding sheer), must be under the direction of a person licensed as master or mate (pilot) of towing vessels . . . ." The regulation excludes certain towing vessels, such as those engaged in assistance towing or those of less than 200 gross tons engaged in offshore mineral or oil exploitation.

reported to investigators that the master was not the subject of any suspension or revocation proceedings.

The master's work schedule was 21 days on duty, 7 days off duty. When he was on duty, he worked from 0600 until 1630.

Deckhand. The *Miss Megan* deckhand, age 44, had been employed by Central Boat Rentals since January 2003. He was one of two survivors of the accident.

The deckhand reported no unusual events in his schedule before the accident. His work schedule was 21 days on duty, 7 days off duty. When he was on duty, he worked from 0600 until 1630.

Athena 106

Spud Winch Operator. The *Athena 106* spud winch operator, age 25, had been employed by Athena Construction since May 2006. The operator, who survived the accident, reported no unusual events in his schedule beforehand. He was on a regular work schedule that he described as "repetitious." He arrived home the previous day around 1730 and went to sleep by 2130. On the morning of the accident, he awoke at 0530 and was picked up by two other barge crewmembers at 0620 for the ride to Ivanhoe dock. From the dock, they were taken out to the barge by a crew transport boat, about a half-hour ride. The spud winch operator indicated that this was his normal daily routine.

Other Crew. Four crewmembers on the *Athena 106* died in the accident. The barge foreman was 51 years old at the time of the accident, the crane operator was 59,

and the two barge hands were 36. One barge worker, age 33, was officially listed as missing at the time of this report.

The foreman had been employed by Athena Construction since 2000. All the other crewmembers were hired in 2006.

Vessel Information

Miss Megan

The steel-hulled towing vessel *Miss Megan* was built in 1996 in Morgan City, Louisiana, and was previously owned by Gaudet Boat Rentals of Morgan City. According to the certificate of documentation issued by the Coast Guard in June 2006, the 52-gross-registered-ton[9] vessel was 52 feet long and 20 feet wide. Its draft was about 5 feet[10] and its transit speed was about 6 knots. The *Miss Megan* was not inspected by the Coast Guard, nor was it required to be.

Athena 106

Construction. Documents provided by Athena Construction indicate that the construction barge *Athena 106* was delivered new in May 1982 at a cost of $143,000. The barge, which had a steel hull, was built by Gulf Coast Fabrication, Inc., in Pass Christian, Mississippi. The barge was not inspected by the Coast Guard, nor was it required to be.

[9] Gross tonnage represents the total internal volume of a vessel, with some exemptions for nonproductive spaces.

[10] Draft is the vertical distance from the lowest point of a ship's hull to the waterline.

The *Athena 106* was 110 feet long, 36 feet wide, and measured 7 feet from the bottom of its hull to the deck where the crew worked. Both ends were raked, or sloped (**figure 2**). The bottom of the hull was flat. The draft of the *Athena 106* was approximately 4 1/2 feet.

Equipment. The *Athena 106* was the primary working platform for the crew (**figure 7**). Its deck contained all the equipment necessary for extracting and driving pilings around docks, oil rigs, and other platforms in the oil field. The equipment included the spud winch (described in detail below) used to raise and lower the spuds that anchored the *Athena 106,* and a crane to hoist and position the pilings for driving or to maneuver them onto the barge alongside for storage. Other equipment included a piling extractor with hydraulic powerpack, oxygen and acetylene bottles, chainsaw, deck generator for electrical equipment in the doghouse, air compressor, hand tools, and crane accessories.

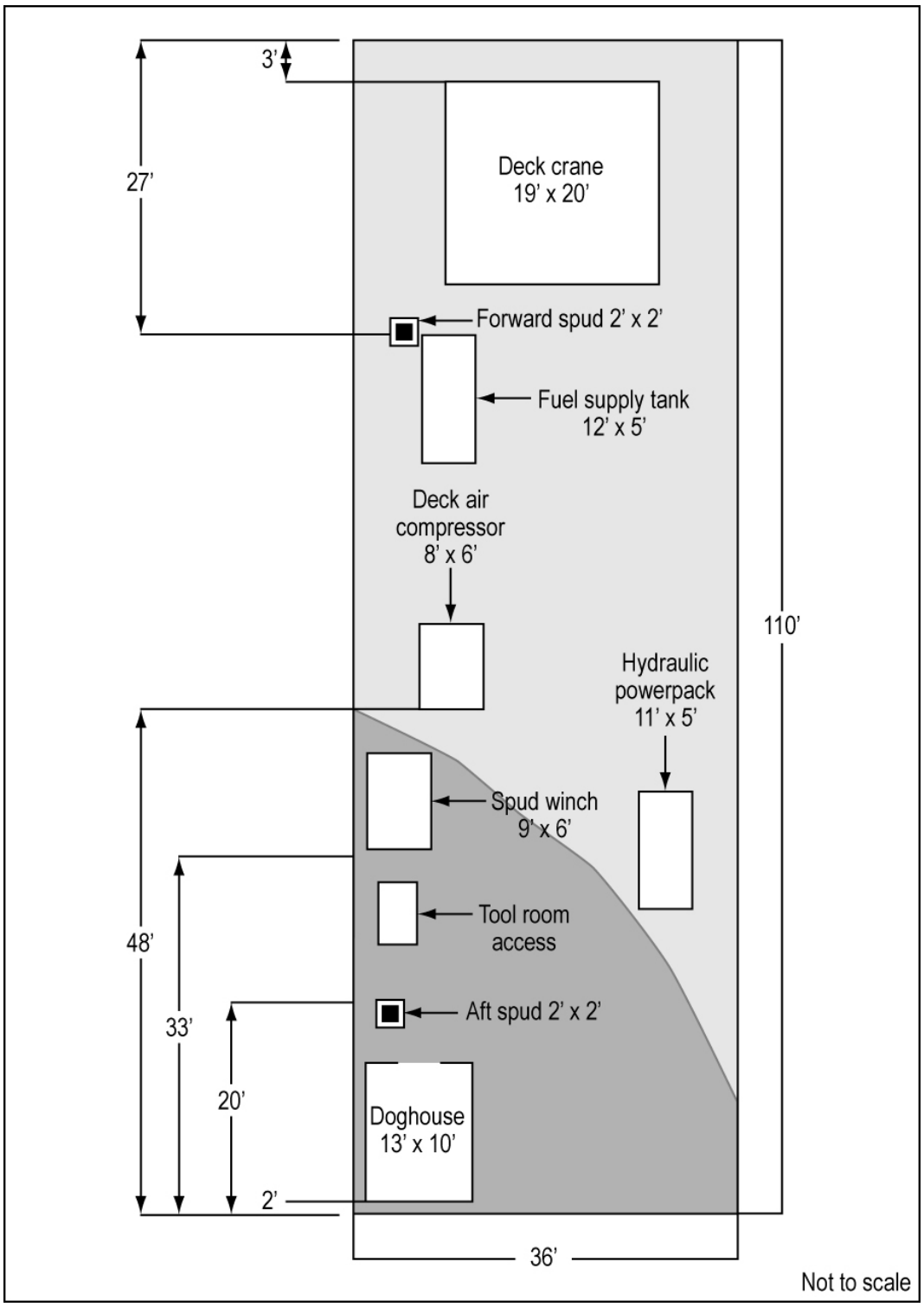

Figure 7. General layout of *Athena 106* construction barge. Fire damage to equipment on the barge deck was greatest in the dark-shaded area.

IBR 234

Deck barge *IBR 234* was used as a storage platform for the pilings being extracted or installed by the crew of the *Athena 106*. The *IBR 234* had a steel hull and was 120 feet long, 30 feet wide, and 7 feet from the bottom of the hull to the deck. The vessel's draft was about 4 feet. The barge was not inspected by the Coast Guard, nor was it required to be.

Spud Winch Information

Construction

The spud-lifting winch used on board the *Athena 106* was manufactured by American Hoist and Derrick Company. It was a model 120B, manufactured during the 1950s and no longer in production. According to company documents, it had a rated capacity of 12,000 pounds pull at 270 feet per minute and was chain-driven through a twin-disk clutch by a Detroit Diesel engine, model 3-71, rated at 120 horsepower. The winch was 9 feet long, 6 feet wide, and weighed about 8,000 pounds. According to industry professionals, this make and model of winch is used extensively on marine construction barges and is known for its simple, reliable design and operation.

The Detroit Diesel engine powering the winch was mounted aft of the winch. The engine was fitted with a clutch on its output shaft, which was connected by a chain to the winch's drive gears for the drums. A lever connected to the clutch at the operator's seat allowed the operator to engage or disengage the drive engine from the winch drum drives.

The winch was a two-drum design. The upper drum controlled the raising and lowering of the aft spud, and the lower drum controlled the forward spud. Steel cables 7/8 inch in diameter led from the drums to the spuds through a series of pulleys and sheaves (one for each spud). The cables allowed the winch operator to lower the spuds into the soft bay bottom to anchor the barge or to lift the spuds so the barge could move.

Operation

The spud winch operator could control the drums independently, working from a seat mounted on the inboard side of the winch, facing the forward end of the barge (**figure 8**). Each winch drum had two brake bands, one on the outside and one on the inside nearest the operator. Both bands were controlled from the operator's seat, the outer band by a foot lever and the inner band by a hand control lever. Thus, the operator had two foot brake pedals and two hand levers that acted as friction brakes to control the speed of the winch drums as they lowered or raised the spuds. The operator's winch controls also included (1) a single-lever throttle to control the diesel engine's speed, (2) a lever for engaging or disengaging the diesel engine's clutch from the winch drum driveshaft (used only while lifting the spud; lowering the spud was accomplished by gravity), and (3) a lever for each drum to engage or disengage the drum pawls into a notched ring on the drum's outer edge and prevent its cable from paying out accidentally.

According to the *Athena 106* spud winch operator, if the spuds were deployed (lowered) and it was necessary to move to a different work site, he would, at the direction of his foreman, raise the spuds as follows. First, he would start the diesel engine and move to the operator's seat. He would engage the clutch to the winch using the left lever,

then increase the engine speed using the throttle lever to develop enough power to lift the 5-ton spuds. The winch drum would not rotate until he actuated the hand friction levers, which controlled the friction between the winch driveshaft and the drums.

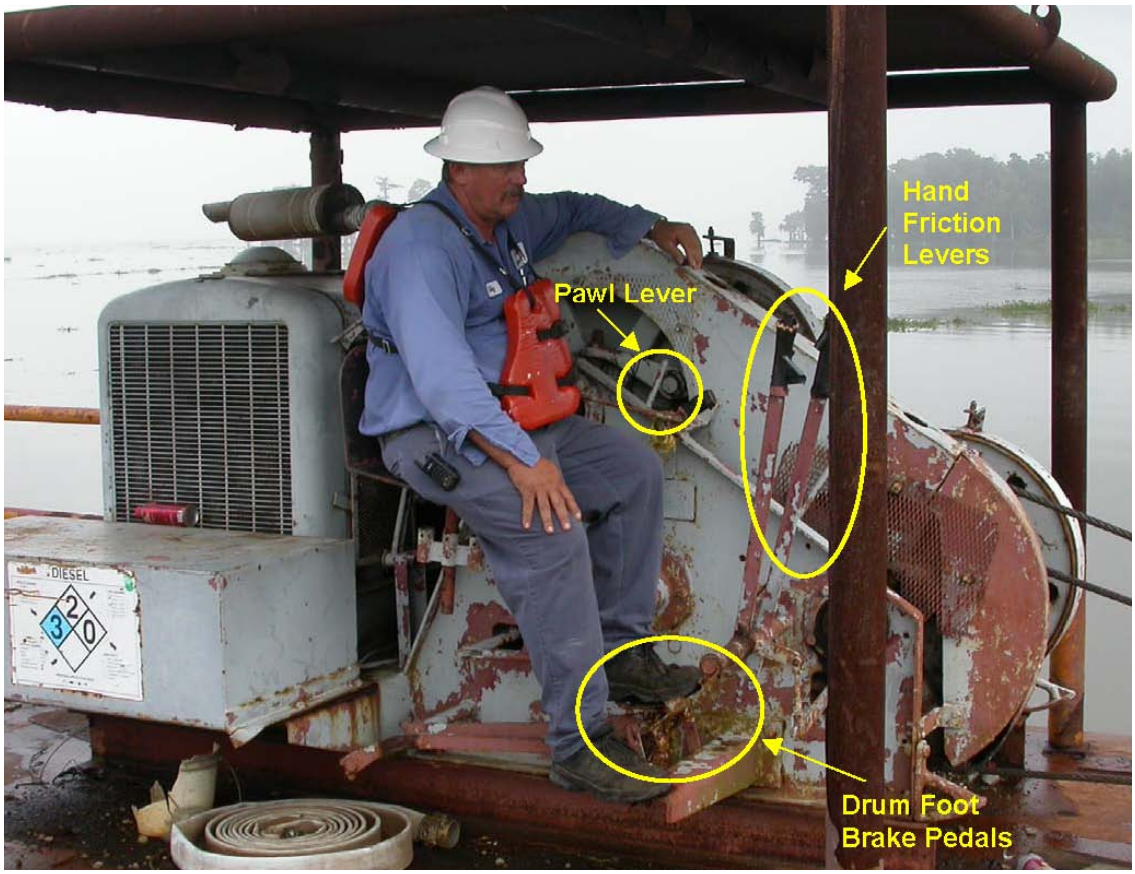

Figure 8. Operator in position at the spud winch on another Athena barge, not the *Athena 106*, used in the salvage operation after the accident. Highlighted are the foot brake pedals and hand levers that controlled the speed of the winch drums as they lowered or raised the spuds, and one of the levers that engaged or disengaged the drum pawls into a notched ring on the drums' outer edge to prevent the cables from paying out. Note the operator's work vest, the flotation device worn by barge workers on the job.

With the engine running and the clutch engaged, the spud winch operator would pull back on the appropriate (forward or aft) spud's hand lever to increase friction to that drum, thereby rotating the drum and lifting the spud at the end of its cable. Once the spud was fully raised, the operator would latch the foot brake in place by depressing it. He

would press down on the heel section of the foot pedal and secure the depressed pedal to a fixed piece of steel connected to the winch frame (**figure 9**). After the foot pedal had locked the spud's drum in place, the operator would relax the hand friction control lever and shut down the diesel engine.

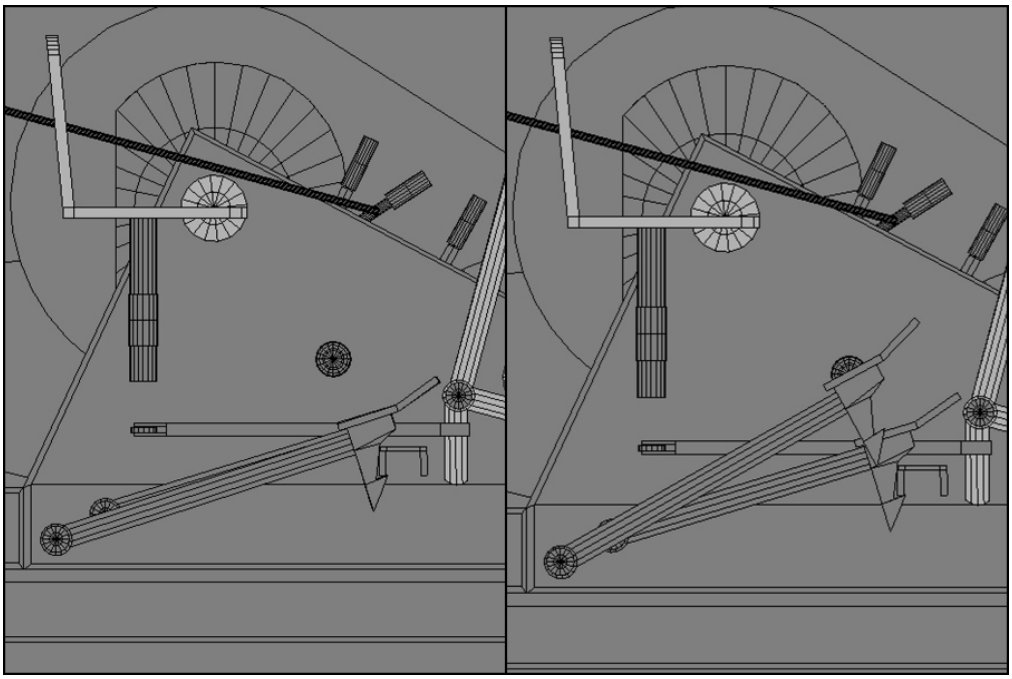

Figure 9. Operation of *Athena 106* foot brake pedals (shown at bottom of both illustrations). On the left, both pedals are engaged (depressed) and latched in place by the fixed steel piece shown pressing on a triangular section at the bottom of the pedals. On the right, the front pedal is released and the back pedal is still engaged. To release the pedal, the operator would push down on the pedal and twist the latch out of place, allowing a spring to raise the pedal. Objects in white are the operator's seat (upper left) next to a round bearing for the upper winch, and the hand friction control lever (lower right) that could be used to brake the winch if the foot pedals disengaged.

Dropping a spud from its raised position was a matter of engaging the hand friction control lever, releasing the latched foot brake, and easing the spud down with the friction of the brake. The spud winch operator explained that tension had to be kept on the cable while the spud was being lowered, as opposed to letting it freefall, to avoid having the cable recoil and foul ("birdnest") on the drum. Care had to be taken in

lowering the spuds. Investigators observed that if operators felt a spud touch something while it was being lowered, they moved the barge slightly to avoid hitting one of the pipelines buried under the bay.

Safety Features

The winch and its associated equipment offered three methods of holding a raised spud in position so it would not drop or slip from its retracted (raised) position:

- Drum brake band foot pedals controlled from the operator's seat.
- A steel pawl that, when engaged, fit into a notched ring fastened to the outer periphery of the drum to keep it from turning backward if the brake failed (**figure 10**).
- A 36-inch-long by 2-inch-diameter steel securing pin (**figure 11**) that could be inserted directly through the spud once it was fully retracted to prevent it from freefalling in the event of a winch or cable failure.

When asked whether he would typically insert the securing pin in a spud after raising it, the *Athena 106* spud winch operator said,

> We never put pins in a spud . . . we never had to. We stayed in the field, you know. Usually when you're going a short destination [distance] . . . a couple of hundred yards away, you really don't put a pin through the spud. I mean I'm sure it's a lot safer to do it, but we don't. I don't know why.

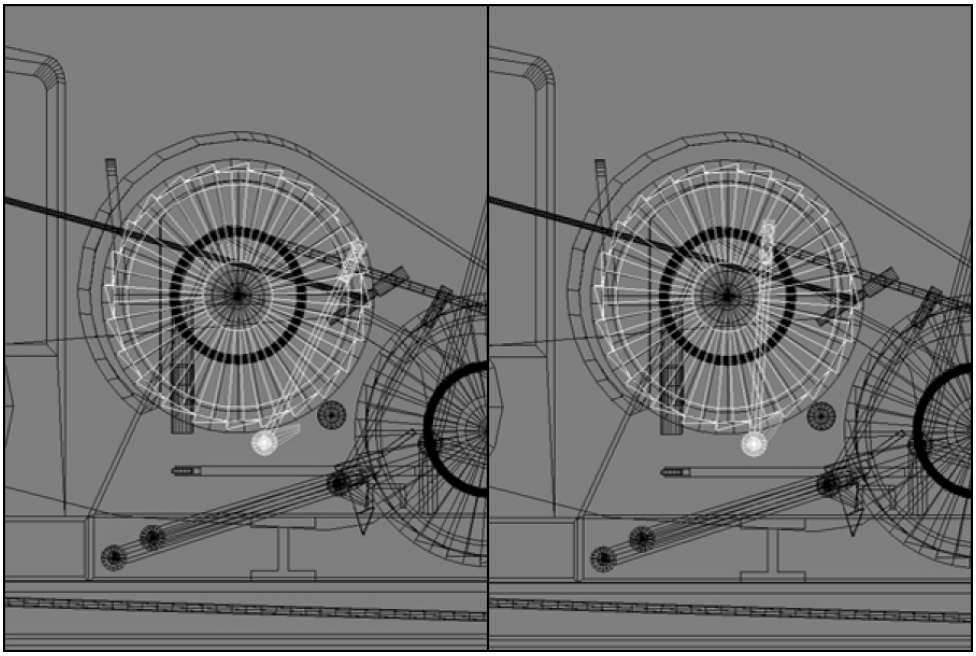

Figure 10. Operation of the winch pawl on the *Athena 106*. Both winch drums are shown. The white ring on the upper drum (which controlled the aft spud) is a ratcheted gear bolted to the outside of the drum. The operator engages or disengages the pawls using the lever, shown in white, that extends downward across the gear. The pawl is the tongue-shaped piece at the bottom of the lever**.** When disengaged (left illustration), the pawl is outside the gear teeth, allowing the gear to move freely in either direction. When engaged (right illustration), the pawl falls into the spaces between the notches so the gear can move in only one direction. (See **figure 8** for location of pawl lever at operator's station.)

Figure 11. Photos showing spud with securing pin lying alongside (left) and with securing pin inserted (right).

Wreckage

Vessels

Two days after the accident, on October 14, Safety Board investigators documented the damage to the vessels involved in the accident. The *Miss Megan* and barge *IBR 234* were anchored at a separate location from the *Athena 106*, which was still at the accident site.

Miss Megan. The *Miss Megan*, which was secured to the aft end of the barges and in the direct path of the flames from the failed pipeline, had been engulfed by the fire. Above the waterline, paint was intact only on the starboard aft side of the vessel. The vessel's entire forward-facing exterior steel structure was scorched to the steel base metal. All windows facing forward or to port had been severely damaged by the heat, as well as all wheelhouse windows. The starboard wheelhouse entrance door was reduced to molten aluminum. The top of the port side wheelhouse door was also melted, but the bottom was intact. Inside the wheelhouse, all navigational aids and maneuvering equipment sustained extensive damage, leaving the wheelhouse virtually an empty shell.

On the main deck, which was one deck below the wheelhouse, the port aluminum door leading to the vessel's engine space was intact. Flame patterns indicated that the port engine space door was open during the fire. The windows next to the engine space were damaged by the heat, and both of the vessel's propulsion engines sustained extensive heat damage. The engine control devices in the wheelhouse were severely damaged, but the position of the transmission shift levers indicated that both engines

were in the neutral position at the time of the fire. The deck winch and other equipment in the forward area of the main deck also suffered extensive heat damage.

The hull below the main deck appeared structurally sound. It showed limited heat damage and no signs of flooding or of having taken on excess seawater after the accident. Investigators did not examine the hull out of the water.

Athena 106. Investigators found both the forward and aft spuds on the *Athena 106* in the lowered position (as noted below, they were informed by the recovery crew that the forward spud had been in the raised position until it fell during the recovery effort). The 7/8-inch steel cables connecting the spuds to the barge's winch were examined for signs of preexisting damage and found to be free of any fraying or other visible defects. The cable leading from the winch to the forward spud exhibited a light strain condition, with its remaining turns wrapped uniformly around the lower winch drum. The cable connecting the aft spud to the winch was found completely fouled on the upper winch drum, or "birdnested," with none of its remaining cable turns on the drum still wrapped on the inner drum surface (see **figure 6**).

The brake pedal for the aft spud was found elevated in relation to that of the brake pedal for the forward spud. Investigators noted a 3/32-inch indentation on the leading edge of the fixed steel piece to which the brake pedal latched. No further wear was found on the underside of the fixed piece. On the brake pedal, the latching mechanism displayed no wear.

Both the upper and lower winch drum hand friction control levers were found disengaged. Both spud winch drum pawls were found in the disengaged position. The

spud winch's fuel tank, integral with the winch frame, was split open and deformed by the fire's heat. The 36-inch-by-2-inch spud securing pins were found lying next to their respective spud bases, not inserted into the spuds.

Investigators could not enter the barge's tool room, accessible by a steel door leading belowdecks forward of the doghouse, because of the water that had accumulated during the firefighting effort. The surviving barge hand reported that water would accumulate daily in the tool room. As part of their daily morning checks, the crew would check to see how much water had accumulated and pump it out as necessary. The barge hand estimated they would pump out from 6 to 10 inches a day. The crew had been pumping the compartment during the 2 weeks before the accident but had not determined the source of the bilge water.

The barge suffered the greatest damage on its port side and aft end, where the fire severely damaged the doghouse, the deck generator, the deck air compressor, and the spud winch. Some small portable equipment and hand tools in the area, such as a chainsaw, were also consumed by the fire. Several oxygen and acetylene bottles used by the crew in their day-to-day operations had exploded from the heat of the fire and were strewn about the deck.

The forward end and starboard side of the barge sustained less heat damage. The hydraulic powerpack (which powered the piling extractor) sustained limited fire damage to its outer housing and minimal damage to the engine and hydraulic equipment inside. The only other piece of significant equipment in the forward area of the barge was the crane, with its boom facing aft toward the doghouse. The wooden support on which the

crane was mounted, the crane operator's cab area, and the outer right side of the crane operator's cab showed signs of the fire, but they did not display the same catastrophic effects as did the equipment at the aft end of the barge. Immediately aft and to the port side of the crane was a large diesel fuel storage tank that showed virtually no signs of heat damage, although the equipment immediately aft of it was destroyed by the fire.

IBR 234. Barge *IBR 234* was secured along the starboard side of the *Athena 106* at the time of the fire. The load of wooden pilings on the deck of the *IBR 234* extended nearly the entire length of the barge. Because the *IBR 234* was close to the *Athena 106*, all its pilings sustained heavy fire damage. The paint was burned off the barge's deck, but the deck appeared structurally sound and intact. The exposed hull periphery of the *IBR 234* sustained minimal damage, except that the paint was burned off, exposing the hull's bare steel.

On-Scene Spud and Spud Winch Examination

Salvage Operation. The recovery crew found the forward spud on the *Athena 106* in the lowered position. According to the Athena Construction barge supervisor who participated in the recovery, the forward spud was in the raised position after the accident but then "just dropped" during the recovery effort.

The day after the accident, a diving company inspected the pipeline and the crater caused by the gas eruption, as described in the "Postaccident Pipe Recovery and Examination" section. The divers believed that the aft spud was tangled with at least one pipe and was possibly close to several others, according to dive reports. The Coast Guard organized a salvage group to develop a plan to extricate the *Athena 106* from the

submerged gas pipeline. Nearby oil and gas production facilities and pipelines were secured, awaiting the repair of the ruptured pipe. After investigators had surveyed the *Miss Megan* and the *IBR 234*, the vessels were moved from the area.

Another Athena barge was dispatched to assist with the salvage of the *Athena 106*. The barge waited a quarter-mile from the accident site, then once the sonar surveys were complete, moved to a position alongside the *Athena 106*. Investigators observed that during the move, the spud winch operator on the salvage barge used only the foot brakes, not the pawls or the securing pins, to secure the barge's spuds in the raised position.

The deck end of the aft spud cable was cut and marked. The crane on the salvage barge pulled the *Athena 106* aft spud out of the water for examination. According to markings on the spud and measurements taken at the scene, the lower end of the spud had been submerged in the mud an estimated 17 feet. The cable, sheave, and deck pulleys were found to be in good working order during the recovery. The 4-inch tip of the aft spud displayed a slight concavity (**figure 12**).

The forward spud was then recovered. The cable, sheave, and pulleys for the forward spud were found to be in good working order.

Spud and Cable Examination. Investigators inspected the aft spud and its support cable 9 days after the accident, on October 21, 2006. The cable was disconnected from the spud so that the underwater portions of the spud could be inspected. The cable was reexamined along its entire length. No fraying or other damage was found.

Figure 12. Aft spud of the *Athena 106* when raised after it had released from its fully raised position and hit a submerged, buried high-pressure natural gas pipeline.

Athena Construction's maintenance supervisor stated that the cables to both spuds on the *Athena 106* had been changed about 2 months before the accident. The maintenance supervisor supplied documentation of the purchase of two spud support cables in July 2006. No written maintenance records for changing the cable could be produced because, as stated by the maintenance supervisor, such records were not kept.

During the same inspection, all deck pulleys and sheaves through which the spud cables led were examined and found to be working satisfactorily. The aft spud was checked for damage sustained during the accident. The only accident-related damage was cosmetic—paint exposed to the fire's heat had burned from the spud's surface.

Postaccident Pipe Recovery and Examination

On October 13, 2006, a diving company, Caldive International, Inc., hired by Gulfport, inspected the pipeline and the crater caused by the gas eruption. Underwater visibility was described as very poor. Divers found a 3-1/2-foot-deep crater centered on the spud. The soil around the crater wall was muddy clay. A diagram completed by Caldive showed the spud between two fractured ends of the gas sales pipeline. Caldive performed a second survey on October 19 and produced another, nearly identical, diagram showing the spud between two fractured ends of the gas sales pipeline.

Athena Construction hired a diving company, River Services Company, to examine the underwater damage on October 13-14, 2006. The River Services Company report states: "The west side of the 6-inch [8-inch][11] pipeline is making contact with the spud" and "the aft spud apparently made contact and cut a 6-inch [8-inch] pipeline." Chevron then contracted to have the pipe recovered. Two lengths of pipe, an east piece and a west piece, each approximately 50 feet long, were recovered from each side of a transverse (circumferential-like) fracture (**figure 13**) on November 17, 2006. After a Safety Board investigator photographed the damaged pipe, it was sent to Stress Engineering Services for analysis (see "Tests and Research" section).

[11] The pipe was actually 8 inches in diameter, but at the time of the underwater assessment, its diameter was thought to be 6 inches.

Figure 13. Fracture on the east piece of the ruptured pipeline.

Waterway and Pipeline Information

According to the *United States Coast Pilot*,[12] East Cote Blanche Bay, West Cote Blanche Bay, and Vermilion Bay form a large body of water separated from the Gulf of Mexico by Marsh Island (**figure 1**). The water area, which extends west-northwest from Atchafalaya Bay, is about 32 miles long and 5 to 15 miles wide. The water averages from 5 to 9 feet deep, and "the shores of the bays and Marsh Island are low and marshy." The *Miss Megan* was on a northwesterly heading moving through the area.

Hydrographic surveys completed after the accident by John Chance Land Surveys, Inc. (see "Tests and Research" section) found that the water in the accident area

[12] National Oceanic and Atmospheric Administration, National Ocean Service, *United States Coast Pilot*, vol. 4 (Gulf of Mexico, Puerto Rico, and Virgin Islands), 32nd ed., 2004, p. 466.

was between 6 and 7 feet deep, corrected for tidal height. The survey reported that the crater created by the accident was "approximately 3.5 and 4.0 feet lower in elevation than that of the normal seafloor elevation, which is probably a result from the explosion."

The pipeline was an 8.625-inch (outer diameter), X46 grade, electric-resistance-welded steel pipe with a 0.250-inch wall thickness. The pipe was manufactured in Bethlehem Steel's factory at Sparrows Point, Maryland, in November 1965. The pipeline was externally coated with a spiral-wrapped, asphalt-type material, followed by a 1.5-inch-thick concrete coating.

A postaccident dive survey estimated that the pipeline had about 3 feet of cover when the accident occurred. Texaco[13] had performed a depth-of-cover survey on the pipeline in 1992 that showed a burial depth of between 2 and 2 1/2 feet. The pipeline was cathodically protected to inhibit corrosion. During a cathodic protection survey on August 24, 2005, readings of -1.323 and -1.069 volts were recorded at two different platforms, meeting the criteria of NACE International[14] publication RP0176-2003, *Corrosion Control of Steel Fixed Offshore Structures Associated with Petroleum Production*. In a February 2006 pressure test after Hurricane Katrina, the pipeline held a pressure of 1,000 psig for 4 hours. Chevron reported that the pipeline did not need repairs and that there were no problems with it until it ruptured on October 12, 2006.

[13] Texaco constructed the pipeline about 1966 (the date when the pipeline construction bid was approved). In 1987, Texaco sold a 50 percent interest in the pipeline and in the West Cote Blanche Bay production field to Tesla Resources, Inc., the predecessor to Gulfport. In 2001, Texaco merged with Chevron, and Texaco's 50 percent interest stayed with the new company.

[14] NACE International is an organization concerned with corrosion issues. The organization produces consensus standards.

At the point where it was struck, the gas sales pipeline ran roughly east to west under the bay (**figure 1**). West of where it was struck, the pipeline made a 90-degree turn north. At the east end, the pipeline began at the Gulfport sales platform (**figure 14)**. The sales platform was in Gulfport's West Cote Blanche Bay production field (state lease 340). At the west end, the pipeline terminated at Chevron's bay junction platform, where it tied into Chevron's Vermilion Bay gas sales pipeline. A check valve downstream of the tie-in prevented backflow from the downstream gas-gathering system.

Figure 14. Beginning of the gas sales pipeline (vertical pipe entering water) at the Gulfport sales platform in the West Cote Blanche Bay oil field. The pipeline was ruptured by the *Athena 106*'s aft spud in an east-west section near the Gulfport platform. The pipe's concrete coating is visible above the waterline.

Meteorological Information

According to National Weather Service data from its station in Patterson, Louisiana, 25 nautical miles east of the accident site, skies were clear at 1155 on the day of the accident and visibility was 10 miles. The temperature was 81° F and the wind was from the south at 6 knots. The area forecast was for seas of 1 to 3 feet.

Medical and Pathological Information

Medical Information

The Athena Construction workers who rescued the *Miss Megan* deckhand also recovered the body of the barge foreman from the water. The deckhand and the foreman's body were brought to the Ivanhoe dock, where St. Mary Parish sheriff's officers and Acadian Ambulance personnel met them.

Acadian Ambulance Unit 24 transported the *Miss Megan* deckhand to Iberia General Hospital. He suffered second-degree burns over 27 percent of his body and spent one night in the hospital's emergency room before being transferred to a nearby burn unit. The A*thena 106* spud winch operator, who swam away from the fire and was rescued by the crew boat *Captain Mitch*, did not suffer any injuries as a result of the accident and was not hospitalized.

The *Miss Megan* master died on the towing vessel. His remains were found on the *Miss Megan*'s deck outside the wheelhouse. Searchers recovered three bodies of barge personnel, each suffering varying degrees of burns. The bodies of two barge hands were

not found. One of those individuals has been declared dead and the other was officially listed as missing at the time of this report.

Toxicology Testing

Coast Guard regulations at 46 CFR 4.06 require that drug tests be conducted within 32 hours of a serious marine incident and that alcohol tests be conducted within 2 hours "unless precluded by safety concerns directly related to the incident." [15] Alcohol testing is not required more than 8 hours after a serious marine incident.

The bodies of the four recovered crewmembers were tested for both drugs and alcohol. The results were negative.

The two survivors were tested for drugs but not alcohol. The *Athena 106* spud winch operator was tested for drugs immediately after his rescue. The *Miss Megan* deckhand was not tested until 6 days after the fire because of his injuries. Both drug tests were negative.

The deckhand was taken to the hospital immediately after he returned to shore and was not tested for alcohol. The spud winch operator did not return to shore within the 2-hour testing limit because, after the crew boat rescued him, he stayed on board while the crew shut off valves for wells to secure the oil field. A sergeant from the St. Mary

[15] Federal regulations at 46 CFR 4.06 require postaccident drug and alcohol testing on "each individual engaged or employed on board the vessel who is directly involved in" any accident meeting the criteria of a serious marine incident, defined at 46 CFR 4.03-2 as (a) a marine casualty or accident that results in any of the following: (1) one or more deaths, (2) injury that requires medical treatment beyond first aid and renders the individual unfit to perform routine duties, (3) property damage exceeding $100,000, (4) actual or constructive total loss of an inspected vessel, or (5) actual or constructive total loss of any uninspected vessel that exceeds 100 gross tons; (b) discharge of 10,000 or more gallons of oil into U.S. waters; or (c) the release of a reportable substance into the environment of the United States.

Parish sheriff's office met both survivors as they arrived at the Ivanhoe dock. The sergeant did not report evidence of alcohol use by either survivor.

Company Information

Central Boat Rentals

Central Boat Rentals, Inc., owned and operated the *Miss Megan*. The company had been in business since 1967 in the inland and offshore waters of Louisiana, Texas, Mississippi, and Alabama. The company primarily serviced the inland and offshore oil and gas industry. Central Boat operated 20 vessels and 118 barges, including 7 spud barges.

Central Boat Rentals had a health and safety manual and an employee-training program. The manual outlined the company's safety policies and contained guidance for its workers on safe workplace practices. It did not contain specific guidance or any requirement for a barge in tow to have its equipment properly secured before getting under way.

Athena Construction

Athena Construction was under contract to Gulfport Energy of Oklahoma City, Oklahoma, to perform construction operations in its oil field in the West Cote Blanche Bay area. The company operated nine spud barges, had 40 employees, and had been in the marine construction business for over 30 years at the time of the accident. Each barge was equipped for a variety of work, including driving and extracting pilings. The *Athena*

106 barge worked steadily in the Gulfport Energy oil field after hurricanes Katrina and Rita.

At the time of the accident, Athena Construction was repairing the pilings used to secure oil and gas drilling and production facilities. Gulfport officials would tell the Athena supervisors what needed to be done, and the barge supervisors would complete the work.

Athena Construction had a health and safety manual and an employee-training program. The manual outlined the company's safety policies and contained guidance for its workers on safe workplace practices. The manual included a procedure for securing barge spuds when performing electrical work, but it did not contain specific guidance or requirements for securing the spuds with safety devices before moving a barge during normal operations.

Athena Construction was involved in a previous spud barge accident. On February 7, 1997, the *Athena 107* barge was "spudded down" in the Rabbit Island Field in Atchafalaya Bay, Louisiana, installing pipe. The barge had been left unmanned. In the early morning hours of February 8, 1997, wind and sea moved the *Athena 107*, causing it to strike and rupture a 20-inch natural gas pipeline owned by Bridgeline Gas Distribution, LLC. No fire was reported as a result of the accident.

Survival Factors

Emergency Response

The local 911 dispatcher received a call at 1158 from a man on a boat in West Cote Blanche Bay, near Marsh Island. The caller reported what he thought was a platform or a boat on fire in the bay. Dispatch transferred the call to the Coast Guard District 8 Command Center, which transferred him to Coast Guard Sector New Orleans Command Center. Sector New Orleans is responsible for Coast Guard activities in the area under the command of the Captain of the Port, New Orleans; that area includes Morgan City and West Cote Blanche Bay.

At 1205, Sector New Orleans received notification of the fire and began coordinating the Coast Guard response. Sector New Orleans briefed District 8 and requested air support. Within 15 minutes, at 1220, an HU-25 Falcon jet aircraft (CG 2127) launched from the Coast Guard Aviation Training Center in Mobile, Alabama, about 225 miles from the accident site, and proceeded to the accident site. At 1223, an HH-65 Dolphin helicopter (CG 6565) took off from Coast Guard Air Station New Orleans, about 100 miles from the accident site. Sector New Orleans contacted St. Mary and Iberia parishes to request surface search and rescue support. The parishes each launched two patrol boats, based about 12 miles from the accident site. The Louisiana Department of Wildlife and Fisheries, also notified by 911 dispatch, sent several boats.

The Coast Guard HU-25 Falcon aircraft, the first official response asset on scene, confirmed flames on the *Miss Megan* and both barges, as well as flames from the ruptured pipeline rising approximately 100 feet from the water surface. Two Louisiana

Department of Wildlife and Fisheries officers were the first law enforcement personnel to arrive by water. They were working 15 miles away from the closest boat launch at Cypremort Point, about 2 miles from the accident site, when they received a call from 911 dispatch. They said they saw smoke from miles away as they traveled to the boat launch. It took approximately 20 minutes for them to get to Cypremort Point, launch the boat (a 19-foot Boston Whaler), and travel to the accident site.

Marine units from St. Mary and Iberia parishes were on scene by 1300, along with the Coast Guard Dolphin helicopter and two additional Louisiana Department of Wildlife and Fisheries patrol boats. Law enforcement and Coast Guard assets organized grid searches for survivors. Also assisting with the search efforts were various crew boats, small boats, and fishing vessels in the area. An incident command post was established at Cypremort Point at 1615 and staffed by personnel from St. Mary and Iberia parishes and Coast Guard personnel.

Two land-based fire departments responded to the emergency. Cypremort Point Volunteer Fire Department was closest to the accident site. Four Corners Volunteer Fire Department provided medical assistance at the Ivanhoe dock. Neither fire department had marine firefighting capabilities. Two towing vessels equipped with fire pumps and hoses,[16] the *Yancy O* and the *Miss Joann*, and one jack-up boat,[17] the *Tiger*, all of which were working in the field, diverted to assist after seeing flames and smoke. Over the

[16] Requirements for fire suppression equipment on towing vessels are found at 46 CFR 27.301.

[17] A jack-up boat is a self-propelled motorized boat with three or four adjustable legs that ratchet up to lift the boat out of the water.

course of several hours, the three vessels extinguished the fires on the *Miss Megan* and the two barges (**figure 15**).

Figure 15. Towboats *Miss Joann* and *Yancy O* fighting the fire on the *Miss Megan* and the deck barge *IBR 234*. (Photo courtesy Louisiana Department of Wildlife and Fisheries)

The first towing vessel to arrive on scene was the *Yancy O*. The captain of the *Yancy O* estimated that he was working 3/4 mile from the fire when he noticed it. The captain stated that the only part of the three vessels not engulfed in flames was the stern of the *Miss Megan.* He got under way immediately but said that it took him between 15 and 20 minutes to reach the scene because his vessel was slowed by a low tide.

At first, because of the intensity of the fire, all he and his deckhand could do was scan the water for survivors and wait for the fire to calm. After 15 to 20 minutes, the lines holding the two barges together burned away, and the *Miss Megan* and barge *IBR 234* began to drift into the oil field. As soon as the towboat and the deck barge cleared the *Athena 106*, the *Yancy O* began to fight the fire. The captain piloted the vessel while the deckhand manned the firehose.

The *Yancy O* put water on the fire for over 30 minutes, then maneuvered close enough to attach a 20-foot towline to the *Miss Megan*'s port quarter and tow the *Miss Megan* and the *IBR 234* to a perimeter light,[18] where they were secured. Meanwhile, another tugboat, the *Miss Joann*, arrived, followed shortly by the jack-up boat *Tiger*. Both vessels helped fight the fire while the *Miss Megan* and barge *IBR 234* were being towed. According to the *Miss Joann* captain, it took 2 1/2 to 3 hours to put out the fires on the *Miss Megan* and the *IBR 234* and another hour to extinguish the fire on the *Athena 106.* The Coast Guard reported that the fires were extinguished at approximately 1530.

Emergency Equipment

The *Miss Megan* was considered an uninspected towing vessel for the purpose of Coast Guard regulations. As the name implies, uninspected towing vessels are not required to be regularly inspected. They must, however, comply with minimum Federal safety regulations. Civil penalties can be assessed if uninspected towing vessels are boarded by the Coast Guard and found to be noncompliant. The regulations for

[18] A four-piling cluster with a blinking light on a platform used to mark the perimeter of an oil field.

uninspected vessels are found at 46 CFR Parts 24-28 (subchapter C). The last Coast Guard examination of the *Miss Megan* was on May 11, 2006.

Deck barges such as the *Athena 106* and *IBR 234* are not subject to Coast Guard inspection.

Lifesaving Equipment. The *Miss Megan* was required by 46 CFR 25.25-5(c) and (d) to carry a serviceable Coast Guard–approved life preserver for each person on board and one approved ring buoy. The deckhand was recovered wearing a flotation work vest. The master was not wearing a flotation device at the time of the accident.

According to Athena Construction company policy, employees were required to wear Coast Guard–approved flotation-type work vests when working on the deck of a barge or other vessel. The flotation vest was to be fastened when worn.[19] The only body recovered wearing a flotation work vest was that of the barge foreman. All crewmembers in the *Athena 106* doghouse had taken their work vests off while eating lunch, a normal practice allowed by company policy. A ring buoy was found attached to the crane's catwalk after the accident.

Firefighting Equipment. As a towing vessel, the *Miss Megan* was required by 46 CFR 27.303 to carry three B-I hand-portable fire extinguishers based on its length, and either an approved B-V semiportable fire-extinguishing system or a fixed fire-extinguishing system to protect the engineroom.[20] According to a Coast Guard inspector

[19] Athena Construction Company Policy Manual, section 2, pp. 14 and 40.

[20] Class B extinguishers are for fires involving flammable liquid, grease, or gas. B-I extinguishers hold 2.5 pounds of dry chemical. B-V extinguishers are available in a variety of sizes and with different types of extinguishing agents.

stationed in Morgan City, the *Miss Megan* carried a type B-V extinguisher. The vessel survey done in 2005 lists two 20-pound extinguishers in the engineroom and one extinguisher each in the pilothouse, upper bunkroom, and galley. Investigators were unable to examine the firefighting equipment on board at the time of the accident because of the extensive fire damage.

Athena Construction company policy contained general instructions for preventing workplace fires. The policy did not include requirements for firefighting equipment on barges. According to a company representative, the *Athena 106* carried at least three fire extinguishers. Two identifiable extinguishers were found during the postaccident examination.

Regulators

Coast Guard Authority

Although the towing vessel *Miss Megan* was not inspected, the Coast Guard and Maritime Transportation Act of 2004 (Public Law 108-293, enacted August 9, 2004) added towing vessels to "Vessels Subject to Inspection" under Title 46 *United States Code*, section 3301. In addition, section 3306 was amended by adding the following: "The Secretary [of Homeland Security] may establish by regulation a safety management system appropriate for the characteristics, methods of operation, and nature of service of towing vessels." In responding to the act, the Coast Guard has proposed a safety management system that will place towboat masters clearly in charge of safety, and that will require companies to establish safe operating procedures that take into account the risks of each voyage. The new law will apply to the *Miss Megan*, if it is brought back into

service. At the time of this report, the Coast Guard was drafting the inspection regulations.

Deck barges such as the *Athena 106* will remain not subject to inspection.[21] According to American Waterway Operators, the national trade association for the U.S. tugboat, towboat and barge industry, more than 4,000 deck barges operate across the country, using different types of winches and other equipment in a variety of different operations. Coast Guard data show that 305 people were fatally injured on barge/tow combinations between 1997 and 2006 and that 379 explosions or fires occurred on barges or towboats during the same period, killing 14 people.

The Coast Guard regulates all aspects of maritime safety on inspected vessels. OSHA refers complaints regarding workplace conditions of seamen on inspected vessels to the Coast Guard, but regulates workplace safety for employees other than seamen working on inspected vessels. OSHA has jurisdiction over workplace safety for workers on uninspected vessels. On the same vessels, Coast Guard oversight is limited to fire and lifesaving equipment and overall navigational matters.

In 1983, the Coast Guard and OSHA signed a memorandum of understanding describing their respective roles in relation to inspected vessels (**appendix B**). The memorandum of understanding was "intended to eliminate confusion among members of the public with regard to the relative authorities of the two agencies." The memorandum of understanding did not address uninspected vessels.

[21] The Coast Guard inspects barges that carry hazardous materials, petroleum products, or other oils (46 CFR subchapters D and O).

OSHA Authority

The maritime safety role of the Occupational Safety and Health Administration, an agency of the U.S. Department of Labor, involves primarily the regulation of shipyards, longshoring, and marine terminals. The agency acts when there is an accident, a complaint, or as part of a nationwide "special emphasis program" focused on particular workplace safety hazards. The Maritime Advisory Committee for Occupational Safety and Health (MACOSH) was reestablished in 2006 to advise OSHA on matters relevant to the safety and health of workers in the maritime industry, including enforcement, training, and outreach. OSHA issued guidance about its role in marine safety on November 8, 1996.[22]

The state of Louisiana defers to the Federal Department of Labor and does not have its own occupational health and safety rules. After the accident, Athena Construction notified OSHA that it had been involved in an accident resulting in fatalities. The local OSHA office in Baton Rouge was first told that it was a marine accident and deferred to the Coast Guard to investigate. OSHA later joined the Safety Board investigation as a party.

OSHA also conducted its own enforcement investigation to determine whether any of its standards had been violated. On March 29, 2007, OSHA issued a citation to Athena Construction (**appendix D**) for a serious violation of section 5(a)(1) of the Occupational Safety and Health Act of 1970. According to information received from Athena Construction, OSHA and Athena reached a settlement agreement on April 20,

[22] Occupational Safety and Health Administration, "OSHA/U.S. Coast Guard Authority Over Vessels," OSHA Instruction CPL 2-1.20 (see **appendix C).**

2007, in which they agreed that setting the brakes and pinning the spuds in the raised position could be safely done. The agreement contained the following abatement method and remedial measures:

> All employees have been instructed that before a barge is moved, the spuds are to be raised such that the pin hole is above the resting area of the pin. Each spud and the winch are to be manned throughout the barge's move. In the event of a power failure of the tug or an imminent collision or allision, and it is necessary to lower the spuds to stop the barge, the Supervisor will direct the workers at the spuds to remove the pins, and the winch operator will be directed by the Supervisor on how and when to lower the spuds. When the equipment is not manned and is under tow, the spuds will be raised and pinned.

Coast Guard/OSHA Relationship

The OSHA instruction of November 1996 broadly outlines the role of each agency. Regarding the Coast Guard, the instruction states (p. 9):

> The U.S. Coast Guard conducts limited safety checks on "uninspected vessels." The Coast Guard has regulations dealing with, and conducts safety checks of, working conditions on commercial uninspected vessels involving personal flotation devices, lifesaving equipment, fire extinguishing equipment, fire fighting equipment, ventilation of engine bilges and fuel tank compartments, and back-fire traps/flame arresters on inboard engine carburetors using gasoline as a fuel. Any other working condition on board a commercial uninspected vessel is subject to OSHA authority.

Regarding OSHA, the instruction states (p. 10):

> OSHA may exercise its authority to cite all employers for all violative working conditions affecting their employees on uninspected vessels when such violations occur within OSHA's geographical jurisdiction and when such violations are not specifically addressed by a Coast Guard regulation.

> 1. An owner, operator, agent or master of an uninspected vessel may be cited for hazards to which **any employees, including seamen** [emphasis in original], it employs are exposed if the hazard is not regulated by the U.S. Coast Guard.
>
> a. . . .
>
> b. Identified recognized hazardous situations that are causing or are likely to cause death or serious physical harm for which there are no specific standards will be cited under the provisions of Section 5 (a) (1) of the OH Act.

In October 2001, the U.S. Supreme Court heard the *Chao v. Mallard Bay Drilling Company* case (00-927). The case involved an explosion on an uninspected oil and gas exploration barge (rig 52) in Louisiana that killed or injured several workers. The Coast Guard did not cite the operator for violations, but OSHA did. The operator challenged OSHA on jurisdictional grounds, but in a decision dated January 9, 2002,[23] the Supreme Court held 8-0 that in areas where the Coast Guard did not exercise inspection authority, OSHA could.

> To determine whether Coast Guard regulations have pre-empted jurisdiction over Rig 52's working conditions, it is thus necessary to examine the contours of the Guard's exercise of its statutory authority. With respect to *inspected* vessels, the parties do not dispute that OSHA's regulations have been pre-empted because the Coast Guard has exercised its broad statutory authority over workers' occupational health and safety, 46 U.S.C. §3306. Indeed, OSHA and the Coast Guard signed a Memorandum of Understanding recognizing that the Guard has displaced OSHA's jurisdiction over all working conditions on inspected vessels, including those not addressed by specific regulations. In contrast, the Guard's regulatory authority over uninspected vessels is more limited. Its general maritime regulations do not address the occupational safety and health concerns faced by inland drilling operations on such vessels and, thus, do not pre-empt OSHA's authority in this case. And, although the Guard has engaged in a limited

[23] *Chao v. Mallard Bay Drilling, Inc.*, 534 U.S. 235 (2002).

exercise of its authority to regulate specific working conditions on certain types of uninspected vessels, respondent has not identified any specific regulations addressing the types of risk and vessel at issue here.

State of Louisiana Authority

As noted above, Louisiana does not exercise any occupational health jurisdiction and defers to the Federal agency (OSHA). The state does not inspect commercial vessels in navigable waters, a role reserved for the Coast Guard. The state's Department of Natural Resources exercises limited authority over the pipelines in Louisiana and was a party to this investigation.

Tests and Research

Sonar Survey

Chevron contracted with John Chance Land Surveys, Inc., by agreement of the National Oceanic and Atmospheric Administration and the Coast Guard, to conduct extensive sonar surveys of the area after the accident to determine the water depths and to detect any hazards to the salvage operation. A preliminary sonar scan around the *Athena 106* showed a depression in the bay floor and extensive scarring of the area. On the basis of the sonar scan, a hydrographic survey, using a side-scan sonar and a single-beam echo sounder, was conducted to map the water bottom near the accident site. The echo sounder results indicated that the corrected mean lower low water depths in the vicinity of the accident were 6 to 7 feet.

The surveyors could not determine exactly what caused the scarring of the bay floor, although some scars were identifiable as made by a propeller. The report stated:

"the depression in the seafloor near the pipeline has disturbed the natural bottom significantly enough that a determination of the ATHENA barge dragging an object, which may have caused the pipeline to rupture, cannot be made."

Spud Winch Examination

On December 6, 2006, Safety Board investigators visited Athena Construction's maintenance facility in Morgan City to further examine the *Athena 106*'s spud winch. The winch, still secured to the deck of the barge, was unfastened and lifted by crane to shore where it could be examined in detail.

The team first briefly reexamined the physical condition of the winch. The paint had burned from all external surfaces, and the top of the fuel tank, mounted on the winch's base, had split open. The diesel engine powering the winch also sustained extensive damage. The winch's chain guard, on the aft end of the winch opposite the operator's seat, was removed to access the chain and drive sprockets on the clutch and winch drive ends. The drive chain, sprockets, gearing, and all associated components appeared in satisfactory condition, with no sign of accident-related or preexisting damage.

The metal guard covering the winch drum drive gears was removed. Both the drum drive gears and the pinion gear driving them were inspected for shaft, bearing, tooth failure, or other signs of damage. All components were found in satisfactory condition, with no signs of damage or failure. Both drum pawls were inspected and found to be working satisfactorily, with no signs of damage or wear.

The connections and linkages for both the foot pedal brakes and the hand lever friction controls were found in satisfactory condition, with no signs of wear, damage, or disconnected components except for the small amount of wear, noted in the postaccident examination, where the hooked edge of the brake pedal would engage the steel latching bar. The turnbuckles[24] used to adjust the brake bands for both control mechanisms were inspected and found to have threads remaining for further adjustment. The brake band on the upper drum was removed to check for damage to the drum or to the lining on its inside surface. The lining, which was fastened to the inside surface of the steel brake band with steel rivets, was removed and checked for thickness along its entire 5-foot length. The material thickness of the brake band lining for the upper spud winch drum varied from 0.172 to 0.314 inch.

Investigators were unable to acquire a complete, original winch-owner's manual[25] to determine the allowable minimum thickness for the lining material. However, once the lining was removed, all the lining fastening rivets, still fastened in place on the band, were checked for wear. None of the rivet heads showed any signs of wear, damage, or fracturing, which could have occurred if insufficient brake lining material had allowed the drum's steel surface to contact the outer steel brake band surface.

[24] Devices consisting of a link with screw threads at both ends, used to bring the ends closer together and adjust the length of a linkage or connection.

[25] According to its serial number, the winch was built in the 1950s. The manufacturer is out of operation.

Material Analysis of Pipeline

At the Safety Board's request and in coordination with Safety Board investigators, Stress Engineering Services, Inc., in Houston, Texas, examined and tested samples of the ruptured pipeline. The stated objectives of the Stress Engineering Services work were to

> document the overall condition of the pipe, including fracture and weld locations; identify fracture mechanisms, directions, and origins; inspect for foreign object damage and pre-existing conditions; measure the pipe diameter and wall thickness; measure the hardness of the steel; and visually characterize external coatings.

The report completed on February 27, 2007, by Stress Engineering Services described the fractured pipeline as follows:

> The rupture produced both a transverse fracture and a longitudinal fracture in the pipeline. The transverse fracture was located approximately 2.1 feet east of a field girth weld located in the section of pipe referred to as the "west portion." The longitudinal fracture extended from the transverse fracture to the east for a distance of approximately 43.4 feet.

The report identified a reversal in the direction of fracture surface markings and that the reversal was "consistent with a fracture origin area in the bend [in the longitudinal fracture surface]." The report noted that "internal and external corrosion were insignificant."

The Safety Board's materials laboratory reviewed the report and found that "the origin area was associated with a large dent on the pipe exterior above the fracture." The laboratory noted that the features of a bulge in the fracture surface were "consistent with the east portion moving downward relative to the west portion as would occur from

contact at the location of the bulge with a spud moving downward." The laboratory's report stated that, according to the Stress Engineering Services document, "no evidence of preexisting cracks or significant corrosion was observed at the origin area." The laboratory's report stated further: "Results documented in the [Stress Engineering Services] report support the conclusion that the pipe ruptured in overstress due to contact with the spud."